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The effect of banana dose and duration on the decrease of sleep disorders in the elderly

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Article history

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Abstract

Sleep disorder is one of the severe health problems that often occur in 60 years old or above. The consumption of fruits with high tryptophan and melatonin content can decrease sleep disorder. Banana is one of the fruits that contain tryptophan and melatonin. This study aimed to determine the effect of banana consumption on the symptoms of sleep disorders in the elderly. The study is experimental research with pre and post-test control design. Sixty-two samples were selected randomly and divided into three groups: control group, treatment group 1 received 130 grams banana/day (PI), and treatment group 2 received 260 grams banana/day (PII). All treatment group were treated with banana for 14 days. The sleep disorders were measured by using IRS (Insomnia Rate Scale) 3 times before the study, and at day-7 and day-14 during the study. Statistical analysis was performed by using One Way ANOVA test and continued with Post Hoc test. Then, data were examined using Repeated Measure to determine the difference among the durations of administration. There was a decrease in sleep disorders from the beginning of the study (day-7) until the end of the study (day-14) in PI and PII group. PII group was found to have a high decrease with a value of 2.50 points. This study suggested that the administration of banana could reduce sleep disorders in the elderly and can be considered as an alternative supplement to reduce sleep disorders in the elderly.

Optimal health can be achieved by sleeping for 7-9 hours (26-64 years old) and 7-8 hours (65 years old or above). Sleeping in less than 6 hours for people in 26-64 years old and 5-6 hours for 65 years or above is insufficient[1]. Sleeping disorders may cause several health problems. Sleep disorders lead to increase inflammatory cytokines such as IL-6, TNF-α and CRP levels. The increase of inflammatory cytokines was then causing cell damage[2].

People can experience changes in the quality of sleep, along with age[3]. Sleep disorders in the elderly occur due to changes in the circadian rhythm of normal sleep. Along with age, one may experi-

ence a reduction in the amplitude of circadian oscillations in all physiological parameters, including the level of melatonin[4]. The changes in elderly can cause difficulty of maintaining deep sleep (Deep Maintenance Problem), Sleep Onset Problems, and Early Morning Awaking (EMA) with the difficulty of going back to sleep[3,5].

Sleep disorders that happen continuously can increase depression. Many studies showed that sleep disorders might risk depression[2]. This mechanism can be explained through circadian theory. Circadian rhythm is a 24-hour rhythm in physiology and behavior controlled by molecular clocks at the suprachiasmatic nucleus. The primary regulation of circadian lies on the transcription of the feedback cells that served to translate and organize various expressions of biological clock genes. The disorders at the regulation of the biological clock gene of sleep/awake due to ageing and neurodegenerative disease can lead to melatonin production disorder, so it promotes the increase of insomnia and depression[2]. The management of wake up and sleep is affected by the serotonergic system. The change of the serotonergic system of people with depression due to ageing or inflammatory that changes sleep patterns and results in REM (Rapid Eye Movement) sleep disorder[6,7].

Quality of sleep is affected by food supply. A low consumption of fruit will cause the changes of circadian rhythm. The effect of the changes in circadian rhythm causes sleep disorders and cognitive problems which then lead to depression[8]. Research in the UK also proved a significant positive relationship between the low supply of fruit and the quality of sleep[9]. The consumption of fruits that contain tryptophan nutrients as a metabolite of melatonin and that contain serotonin can reduce sleep disorders and improve the quality of sleep[10]. The fruit that contains tryptophan and melatonin (cherry) can improve the sleep quality of healthy adults after being given for 7 days[9]. Other studies also proved that the administration of cherry also has a significant effect on the improvement of sleep efficiency in older people (above 50 years) after 14 days[11].

Banana is widely found in Indonesia and grows throughout the year. The banana tastes are good, sweet, and soft. Therefore, it is consumable by all ages, including elderly[12]. Banana contains a lot of nutrients, including tryptophan and melatonin, which can decrease the sleep disorders[13-15]. Therefore, the current study aimed to determine the effect of banana consumption on sleep disorders in the elderly.

Materials and methods

This study was an experimental research with pre-test and post-test with control group design. The study was conducted in Posyandu (Integrated Service Post) of elderly at Koncara Community Health Center, Purwakarta, which was selected purposively. The samples were selected with simple random sampling. The inclusion criteria were elderly above 60 years old, living around the Integrated Service Post of elderly, Koncara Community Health Service Purwakarta, able to communicate well, and cooperative. The exclusion criteria are taking all of the drug classes of antidepressants, steroids, unwilling to eat the banana, suffering from Diabetes Mellitus, chronic and acute renal failure, tuberculosis, stroke, and diarrhea. Before the study, the total samples were 63. However, at the beginning of the study, 1 sample was drop out. Therefore, 62 people were chosen as samples. They agreed to follow the research process by filling out the informed consent.

The samples were divided into three research groups: control group (K), a group of the patients given only education of nutrition; treatment group I (PI), that given nutrition education and 130-gram ripe banana per day; and treatment group II (PII), that provided nutrition education and 260-gram ripe banana per day. The banana was administered twice a day at 10.00 am and 15.00 pm according to previous research by Putra et al (2018)[16] in the afternoon. The sleep disorder conditions of the research subject were measured using the Insomnia Rating Scale, which had been validated by a Study Group of Biology Psychiatry in Jakarta and the Organization of Psychiatry Profession of Indonesia. Insomnia Rating Scale is a measuring instrument for the sleep disorders of the elderly with an index score of 0-25 obtained from the following 8 assessment components: the amount of daily sleep, the dream during sleep, the feeling of sleep, the duration of sleep, the frequency of awakenings during sleep, the time needed to sleep back after awakening, and the feeling upon waking up in the morning. The interpretation of Insomnia Rating Scale is as follows: score 0-6 = Normal; score 7-12 = experiencing a mild sleep disorder; score 13-18 = experiences a severe sleep disorder and score 19-25 = experiencing a severe sleep disorder.

The measurement of sleep disorders was performed three times during the assessment: before the study, day 7, and day 14. Before the research subject of the study was given nutrition education and checking on the conditions of sleep disorders. The subjects were given a banana for 14 days. On

day 7 and 14, the subject of the study checked the condition of sleep disorders. Data were analyzed using SPSS version 16 with One-Way Anova test and continued with Post Hoc test to determine the effect of the intervention on every treatment group. Repeated Measure test was also conducted to examine the difference between the administration duration.

Results

The distribution of sleep disorders on the subjects was spread in age, gender, occupation, disease history, and nutrient status, which can be seen in table 1. Table 1 showed that mild sleep disorder was mostly suffered by females compared to males, in either control group, PI, or PII by 33.3%, 47.6% and 40%, respectively. The repeated measure test demonstrated that the decrease of sleep disorder was found continuously until 14th day in PI and PII. The decrease of sleep disturbance in the PI gradually declined from 0.81 points (7th day of giving bananas) to 2.43 points (14th day of giving bananas). The decrease in sleep disturbance in the PII ranged from 1.60 points (7th day of giving

bananas) to 2.50 points (14th day of giving bananas). The research subjects with chronic disease mostly have a mild sleep disorder, more than the healthy subjects either in the control group or group PII which is equal to 52.4% and 47.4%. In comparison, the group of PI either those who have a chronic disease and those who have not experienced a mild sleep disorder is equal to 33.3%, while those experiencing a severe sleep disorder are more than those who have a history of chronic disease by 9.5% than the healthy subjects amounted to 4.5%. The subject of nutritional status has more mild sleep disorder in the group of PI, which is equal to 38.1%, and the subjects with nutritional status of obesity experience a mild sleep disorder by 30% in group PII. The subjects who do not work nor experience retirement suffered from a mild sleep disorder, most of which are the control group and PI by 33.3% while PII is only 30%. Severe sleep disorders suffered by the unemployed and retired subjects mostly from PI by 14.3%.

The effect of the intervention of banana on sleep disorders in the elderly can be seen in table 2.

Table 1: The data distribution of sleep disorders for each treatment group

Variable		Total treatment group, n=62												p value[a]
		Control n(%)				PI n(%)				PII n(%)				
		N	R	P	SP	N	R	P	SP	N	R	P	SP	
Age	60-69 years	2(9.5)	11 (521.4)	4(19)	0	3(14.3)	9(42.9)	1(4.8)	0	3(15)	11(55.5)	0	0	0.44
	70-79 years	1(4.8)	2(9.5)	0	0	1(4.8)	4(19)	2(9.5)	0	4(20)	2(10)	0	0	
	80-89 years	0	1(4.8)	0	0	0	1(4.8)	0	0	0	0	0	0	
Sex	Man	1(4.8)	7(33.3)	2(9.5)	0	0	4(19)	1(4.3)	0	3(15)	5(25)	0	0	0.74
	Woman	2(9.5)	7(33.3)	2(9.5)	0	4(19)	10 (47.6)	2(9.5)	0	4(20)	8(40)	0	0	
Job	Working	0	5(23.8)	2(9.5)	0	1(4.8)	3(14.3)	0	0	2(10)	5(25)	0	0	0.42
	Retired	1(4.8)	2(9.5)	0	0	2(9.5)	4(19)	0	0	1(5)	2(10)	0	0	
	Unemployed, Not Retired	2(9.5)	7(33.3)	2(9.5)	0	1(4.8)	7(33.3)	3(14.3)	0	4(20)	6(30)	0	0	
Hospital sheet	Healthy	0	3(14.3)	3(14.3)	0	4(19)	7(33.3)	1(4.8)	0	4(20)	4(20)	0	0	0.22
	A history of a chronic disease	3(14.3)	11(52.4)	1(4.8)	0	0	7(33.3)	2(9.5)	0	3(15)	9(45)	0	0	
Nutritional Status	Thin	1(4.8)	3(14.3)	1(4.8)	0	0	1(4.8)	2(9.5)	0	0	1(5)	0	0	0.25
	Normal	0	9(42.9)	3(14.3)	0	3(14.3)	5(23.8)	1(4.8)	0	4(20)	5(25)	0	0	
	Excessive	0	1(4.8)	0	0	1(4.8)	8(38.1)	0	0	2(10)	1(5)	0	0	
	Obesity	2(9.5)	1(4.8)	0	0	0	0	0	0	1(5)	6(30)	0	0	

[a]p < 0.05, N: Normal, R: light, P: severe, SP: very severe

Table 2: The effect of dose and duration of banana administration against sleep disorders

| Group | Administration duration | | | | | | P[b] |
	Day 0	95% CI	Day 7	95% CI	Day 14	95% CI	
K	8.85±3.18	7.40,10.31	10.28±4.36	8.30,12.27	8.33±3.48	6.75,9.20	0.075
PI	8.76±3.01	7.39,10.13	7.95±3.29	6.45,9.45	6.33±2.93	4.99,7.67	0.005
PII	8.50±2.25	7.44,9.56	6.90±2.55	5.71,8.09	6.00±1.97	5.08,6.92	0.002
p[a]	0.918		0.009		0.024		

GTK: a disruption of the sleep Control group, GTPI: sleep disorders of PI, GTPII: sleep disorders group PII, p[a] = Anova Test, GT = Sleep Disorder, p[b]= Repeated Measure test

Table 2 showed a significant difference in the score of sleep disorders from time to time. The difference occurred in the day of administration, day 7 and day 14 in PI and PII were p = 0.009 and p = 0.024 respectively. A significant difference was not found in the control group (p=0.918)
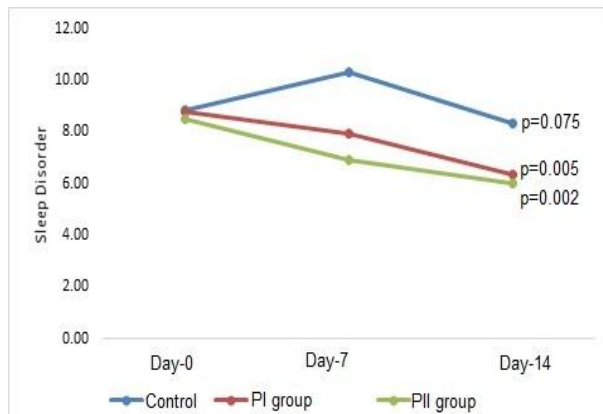

Fig 1. The chart of score reduction of sleep disorders in each treatment group

A reduction in the score of sleep disorders was found at day 7, and another decline happened at day 14 of the study. The reduction occurred in both PI and PII, as provided in figure 1.

Discussion

Table 1 showed that mild and severe sleep disorder was mostly found in women. It was in line with the research conducted in Korea[17] examining the gender differences their factors in the quality of sleep among the elderly. The study proved that women have a higher incidence of sleep disorders than men do. It is closely related to the reduction in the ventrolateral preoptic nucleus (VLPO) on the hypothalamus, which is in charge of managing the rhythm mechanism of the biological clock. This reduction occurs along with age. Women experience a drastic reduction on the volume, and have more cells (62%) at the core of dimorphism sexual within the preoptic area (SDN-POA) while those of

men are less (43%)[17]. Other studies have also proven that older women are more vulnerable to sleep disorder due to sexual hormone reduction. Older women have a low estrogen hormone during the menopause period, which can increase the risk of sleep disorders[18].

A subject with a history of chronic illness experiences sleeps disorder more than does the healthy one. It is consistent with the study by Vega et al[19], which concluded that a person with a history of chronic disease is a predictor of sleep disorders. The pain and discomfort interfere with the sleep quality of the subject, particularly during sleeping at night. Other studies proved that sleep disorders could be associated with an increase in inflammatory cytokines. An high rise in inflammatory cytokines may result in inhibition of the activation of cells and the reduction of the immune response, that leads to peripheral inflammation and increase at the risk of chronic disease[20].

The subjects with an over-nutrition status and obesity suffer more from mild and severe sleep disorders. Research conducted by reducing the night sleep of 1.5 per night for 3 weeks increases 1 kg for one week[21]. Other studies also prove that sleep disorders are predictors of obesity. Short sleep duration cause an increase in appetite due to the response increase in the central neurons to eat unhealthy food and to perform excessive eating. The lack of sleep at night also leads to eating more because it gives more hours awake a day. Lack of sleep also lead to fatigue, decrease in physical activity, and sedentary activity that can cause obesity[22].

The results of this study showed a significant decrease in sleep disorders after banana administration in time dependent manner. The control group also found a reduction in score of sleep disorders, but not significantly different. The decrease in the score of sleep disorders occurs on day-7 and day 14 of the study. The study results are in line with

the research, which suggests that consuming 100 – 140 gram banana twice a day for 7 days decrease the sleep latency of elderly suffering hypertension[23]. Another study conducted by Howatson et al[9], revealed that the improvement of the quality of sleep through consumption of a fruit containing high tryptophan and melatonin, but the study uses different kinds of fruit, which is cherry. It proves that consuming cherry juice as much as 90-100 grams diluted in 200 ml water can increase the time and quality of sleep in adults. Another study also demonstrates that the consumption of cherry juice, 8 ounces for 14 days, can give positively reduce sleep disorders in the elderly[24]. From these studies, it has been proved that the use of fruit with a high tryptophan and melatonin demonstrated an alteration in sleep quality. Interestingly, the present study used banana to patient with sleep disorder exhibited a high decrease in sleep disorder.

The reduction score of sleep disorder in this study due to the synergistic influence between the nutrients of bananas, such as melatonin, tryptophan and others that can improve the metabolic processes of tryptophan and melatonin that reduces the symptoms of sleep disorders. Consuming two bananas or 190 gr can increase the concentration of melatonin serum up to 174 pg/mL or 572%. The concentration of melatonin in a banana is 8.9 ± 0.3 pg/g fresh fruit[13]. Sufficient melatonin levels inside serum can affect the relaxation, decrease in body temperature, and improve sleep quality, the total time of sleep, and sleep efficiency by activating some receptors and melatonin receptor agonists[25]. Some of the nutrients of bananas also affect the reduction of sleep disorders through the metabolism process of melatonin, such as tryptophan. Tryptophan is a serotonin precursor that can reduce sleep disorders in human beings[11]. Serotonin will be sufficiently available inside the brain when tryptophan is also sufficient. Sufficient serotonin can be synthesized to produce enough melatonin. Another nutrient, which is vitamin B6 as a precursor of melatonin biosynthesis, works together with carbohydrates and amino acids in the formation process of melatonin[26].

A reduction in the score of sleep disorders occurs in the administration of 130 gr banana (PI) and 260 gr banana (PII) with an average reduction score of 2.43 in PI and 2.50 in PII. An additional administration of bananas or a change in the time of administration, 1-2 hours before bed, will possibly cause a better reduction in the score of sleep disorders[24]. Banana administration at night could increase the level of tryptophan. Tryptophan plays a role as neurotransmitters serotonin and melatonin[27]. Mela-

tonin is produced by pineal gland, and those hormones will be released into the bloodstream in the evening following a circadian rhythm[25]. The levels of melatonin increase at 9 pm and throughout the night, decreases in the morning, and disappear at 9 am[2,5]. Banana administration at night could increase the melatonin level, so the level of melatonin in the serum was increased. The melatonin addition could improve relaxation and decrease body temperature, so the quality of sleep was increases. There was a limitation in this study. If banana is administered in the night, 1-2 h before sleep, maybe it can decrease the sleep disorder higher than the current study.

The limitation of the current study is the researcher does not measure the levels of melatonin in the blood or urine, so it cannot more objectively determine the increase in the levels of melatonin inside the blood or urine because of banana supplementation.

Conclusion

The administration of banana decreased the score of sleep disorders in the elderly. It suggests that treatment of 260 gram banana lead to a better decrease in score of sleep disorders. Therefore, it can be used as one of the alternative supplementations to reduce the sleep disorder in the elderly. Further research is required to obtain a better decrease in the score of sleep disorders by adding or shifting the time of administration into the night. Further research is needed to measure the levels of melatonin in the blood or urine.

Declarations

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